Darwinian Reasoning and Waltz's Theory of International Politics

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Elimination, imitation and the selection of behaviours

Abstract

There are important parallels between the pattern of inference Kenneth Waltz uses in his *Theory of International Politics* and early Darwinian reasoning. This early Darwinian thinking has needed to be significantly refined by modern evolutionary biologists, and their amendments are equally relevant to Waltz's model. Waltz allows for states to imitate each other, and also accepts that they are only rarely eliminated from the system. Modern Darwinian analyses show that where elimination is rare and imitation common it is quite possible for deleterious behaviours to become widespread. We cannot assume an anarchic system will select for security-enhancing behaviours in major powers. Thinking about Waltz's argument in these terms opens space to disagree with his conclusions while respecting the strength of his logic.

Introduction

In his conclusion to *Realism and World Politics*[1], Booth develops an analogy between the work of Kenneth Waltz and Charles Darwin. There are further fundamental parallels between the two which he leaves unexplored. Both propose models of how selection within complex systems causes the units to converge on certain kinds of behaviour. Darwin shows that most of the animals[2] we see around us have physical characteristics, and instincts, which are almost ideally suited to surviving in their environments because members of past generations which were poorly adapted did not survive and reproduce[3]. Waltz predicts that major players in the international system will behave in ways which are suited to surviving in anarchy[4]. In Darwin's model, units which do not conform with the constraints of the selective system are

either eliminated or fail to reproduce. In Waltz's model, the major powers show relatively little variation in their behaviours in the present because they too are the survivors of competition among units in the past. But both rely on assumptions about how selective systems would have shaped the population of units which constituted them in the past. Both involve assumptions about how selection in the present will shape that population in the future.

These two thinkers are giants in their fields, and for good reason. However, both of their models have been criticised for capturing only part of reality. Over the course of the twentieth century neo-Darwinian biologists have refined, and in some cases rejected, elements of Darwin's own thinking, while retaining his central insights. The parallels between Waltz's reasoning and Darwin's mean that some of these critiques may also be helpful in refining Waltz's 'neorealist' approach to international relations. Clarifying the parallels allows us to tap into over a hundred years of biological thinking on Darwin's legacy[5].

In this paper I examine Waltz's underlying argument that significant states will tend to behave prudently, and draw some parallels with how Darwinians reason about biological evolution. Waltz argues that diversity of states' behaviour is reduced partly by elimination. States which behaved inappropriately in the past were likely to "fall by the wayside"[6] and were either conquered or relegated from geopolitical significance (like Austria or Sweden). Their nonconformist behaviours followed them. However, Waltz's argument cannot rest on elimination alone. He appears to rely on the impact of a few eliminations being multiplied by their exemplary effect, which causes surviving states to imitate the behaviour of their most successful competitors, further reducing the variety of behaviours present among significant states[7]. Yet Darwin's modern successors have shown that this kind of imitation may not automatically make a selective system evolve, because it imports the inherent weaknesses of what evolutionary theorists call a Lamarckian model. I argue that the system Waltz describes

cannot enforce prudent behaviour by itself unless states are guided by policy prescriptions which themselves seem distinctly neorealist.

Darwin and Theories of International Politics

Darwin's name carries a great deal of unfair baggage in the social sciences, which may conceal the usefulness of modern Darwinian thought[8]. I should make clear at the outset that this is not an argument about human nature and that I am not claiming that Waltz appeals directly to Darwin – although there is an indirect link between them.

There is an established tradition of using Darwin's ideas in international relations theory – or more accurately there are two radically different traditions, which conveniently fall into two of Waltz's "images" of international politics[9]. Darwin's name and Darwinian reasoning have been used explicitly to justify claims about human nature, providing "first image" explanations for the pattern of international relations. For example, Thayer[10] claims that Darwinian ideas can bolster the classical-realist contention that human nature is incompatible with global co-operation, a claim based on the belief that we can extrapolate from the challenges humans have faced in our evolutionary history to our modern behaviour[11]. Darwin's ideas have been used more often to support generalisations about human nature than to analyse the evolution of relations among states, despite the logical difficulties of generalising about individuals and a compelling intellectual case for analysing the evolution of state systems in Darwinian terms[12]. When I discuss Darwinian ideas in this paper I am not really thinking about the "first image" implications of Darwinian thought but about "third image" uses of quasi-Darwinian ideas.

The "third image" concerns the complex system which emerges from interaction among states. This system both shapes, and is shaped by, individual states' behaviour[13]. The dominant traditions in the field characterise this system as anarchic. Anarchy is seen as rewarding states which behave in particular ways, therefore we can allegedly form reliable expectations about states' behaviour. States will tend to behave in ways which anarchy has, historically, rewarded. Although portraits of neorealism have been particularly explicit in

their use of Darwinian ideas[14], other traditions also accept that anarchy constrains states to behave in particular ways. They disagree largely about what behaviours selective systems will reward in their constituent states.

These "third image" accounts of social evolution have dismissed some common objections to analogies between the evolution of social institutions and biological forms[15]. For example, it makes no sense to reject such analogies on the basis that social institutions, unlike animals, have unlimited lifespans. Evolutionary processes affect the frequencies of different traits within a population, and what kinds of units exhibit the traits is incidental[16]. Provided that institutions like firms and states can recreate themselves enough to alter their behaviour, the same basic logic applies as if they were regularly giving birth to new institutions. Imitation can transmit behaviours between groups, allowing innovations to circulate between social institutions (like states) just as sexual recombination diffuses favoured behaviours and characteristics through a biological population. The basic principle that Darwinian reasoning can be applied to the evolution of social systems seems well-founded.

These parallels between economics and evolutionary biology nourish a flourishing subfield of 'evolutionary economics'[17]. As a result, there is an established dialogue between the two fields which has kept evolutionary economists up-to-date with modern developments on Darwinian thought. By contrast, few IR scholars maintain close intellectual links with 'modern' Darwinian biologists[18]. Where Darwinian ideas are present in international politics, there is a risk that understandings of Darwinism fixate on essentially nineteenth century evolutionary biology, and underestimate the sophistication of modern Darwinian theories. These theories, like Waltz's *Theory of International Politics*, rest on the selection of behaviours and characteristics coded in individual genes rather than a competition between animals *per se*.

The Economic Analogy and Darwin

Waltz did not self-consciously set out to apply Darwin's theory of evolution to international politics. Waltz does not appeal to Darwin (or other evolutionary biologists) to support his theory. Darwin appears only a handful of times in Waltz's major works[19], and never as a model for Waltz's own ideas. But there is a plausible indirect route by which Waltz could have been influenced by early Darwinian ideas, through the assumptions about selection which were made by Darwin's contemporary followers before the 'modern synthesis' revolutionised Darwinian thinking in the early twentieth century[20]. These influenced several contemporary economists[21].

While Waltz is generating his model of international politics, he returns again and again to analogies with microeconomics[22]. States, the units of selection, are compared with firms in a market. Just as firms have to remain profitable in order to survive, so Waltz's states have to retain enough power to avoid becoming easy victims of their competitors. Both firms and states can also imitate successful competitors. This analogy also parallels Darwinian biology (Table One).

	Waltz	economists	biologists
units	states	firms	animals and other organisms
system	international-political	market	ecological

Table One: The politics/economics analogy, and its relationship to Darwin

To construct his analogy, Waltz relies heavily on the work of economists whose arguments paralleled early Darwinian work. The most obvious is Joseph Schumpeter[23], perhaps best known for his slogan of "creative destruction", the idea that the survival of only those firms best-adapted to consumer demands gives the economy as a whole its dynamism[24]. Waltz began his academic career in the 1940s and 1950s, when he was most exposed to economic theory and began graduate work in economics[25]. The economic theory of that period has been

shown to be heavily inspired by ideas of the survival of the fittest firms in a competitive marketplace[26]. While Waltz himself does not link his model to the evolutionary theories and principles of selection developed by nineteenth-century naturalists, the economics of his youth was informed by early Darwinian assumptions about how selective systems work. For example, early Darwinians tended to imply that the odds of a behaviour being retained within the system would vary directly with the success of the unit which displayed it. It should not, therefore, be too surprising that Waltz's model has a lot in common with early Darwinian thinking. Many modern Darwinian theorists in both biology and evolutionary economics have a very different perspective.

At its most fundamental level, Darwinism is one way of explaining why units in a system evolve over time. Charles Darwin himself did not generate all the theory which has since become associated with his name. Darwin was born into a society which generally accepted that species had changed over time but struggled to explain why without invoking divine intervention. His new contribution[27] was to offer a viable mechanism to explain why this change came about. The mechanism was natural selection. Put simply, siblings' traits vary (for reasons Darwin could not specify) but only some of these traits – physical characteristics or behaviours – are suited to the environment. The siblings with suitable traits prosper at the expense of the others, produce more offspring which tend to resemble them, and fill the world with well-adapted animals.

Darwinian theory offers a particular way of reasoning about how units in a selective system are likely to behave. Units whose behaviour is compatible with the environment will tend to leave more descendents, which will resemble them more than their competitors. Therefore, compatible behaviours will become ever more common and incompatible ones ever rarer. Many Darwinians have argued that under many circumstances competition among units is likely to cause an approximation of 'rational' behavior to emerge. For example,

optimal foraging theory suggests that foraging animals' behavior will converge around strategies which tend to offer the greatest calorie yield per hour of effort[28]. Inefficient foragers will be more likely to die before reproducing, and so with each generation foraging becomes more efficient – or would, were the environment not also in a constant state of flux. The numerical superiority of the well-adapted units will enable them to dominate the selective system itself, thus changing the selective environment faced by units in the future.

In *Theory of International Politics*, Waltz allows that in principle states' behaviours could vary. However, he also sees them as constrained by selection, and goes on to argue that we can identify certain behaviours which are better-suited to states' environment, international anarchy. These will be the behaviours which preserve states' security. States whose behaviours do not preserve their security will "fall by the wayside" and no longer be in a position to shape the international system. Because this has been the case for centuries now, we can expect that the international system of the present will be shaped by security-seeking states[29].

Waltz reasons that, over time, most of the major states will converge around a particular pattern of behaviours. He further implies that we can deduce which behaviours are likely to be favoured by the system, and anticipate that those behaviours will be widespread. The widespread behaviours generate a neorealist international system, which punishes states which do not conform to that pattern of behaviour. This is worth examining in more detail, because it implies that the distribution of behaviours is key to understanding the system.

Structural Realism as Behaviour Selection

Waltz argues that behaviours which make the state exhibiting them more likely to survive in anarchy tend to become more common over time, until eventually they become ubiquitous among the states that matter. For a Realist, of course, the behaviour which is almost always rewarded by anarchy is the pursuit and preservation of power. Waltz, a defensive neorealist, infers that the system is most likely to favour behaviours which enhance power only up until the point at which that state's increasing power starts to become actively harmful to its security, by provoking conflict with fearful neighbours[30]. He expects the behaviours common among the major powers to be those which are correlated with the retention of an optimum level of power, at which the states are most secure.

Waltz reasons that two consequences of anarchy will lead to security-enhancing behaviours becoming ubiquitous. The first is elimination, the second, "socialisation"[31]. Both of these have parallels in Darwinian thought.

Elimination in Theory of International Politics

In principle, sovereign states could behave in a range of different ways. Not all of these will improve their odds of self-preservation. The states which dominate the present will be those which were selected by the international system in the past. In the past there will have been a range of states, some of which behaved in ways that preserved their power, some of which did not. Over time states whose behaviour leads to a loss of relative power will be more likely to be conquered or relegated from major power status; they "fall by the wayside"[32]. Therefore, states which are significant in the international system today will have been concerned to preserve their power in the past, and are more likely than not to behave in ways which preserve their power in the present. This behaviour should enable them to preserve their position in the system.

Elimination in its literal sense does not by itself explain why major powers' behaviour should converge so strongly. While unquestionably states are *sometimes* violently eliminated from the system, Waltz accepts that, empirically, this is quite infrequent, an objection raised by Robert Keohane in the 1980s[33]. This is a crucial point of departure from microeconomics, where the "death rate" for firms is much higher[34] (in evolutionary biology, of course, death is omnipresent). In fact, Waltz even accepts that the relegation of states from great power status is not very common. Nonetheless, he continues to believe that behaviours will converge as a result of the *possibility* of elimination/relegation, stating that

> I fail to understand why Keohane thinks that selection does not work if the death rate of a system's units is low. Selection does take place more swiftly and surely when death rates are high [but where they are low] fortunes nevertheless rise and fall... In the international-political system, states wax and wane even as their death rates remain low. In the international-political system, great powers come and go, although not with great frequency...

He then goes on to remark that

> ... a unit of the system can behave as it pleases. It will, however, fare badly if some of the other parties are making reasonably intelligent decisions. That some states imitate the successful practices of others indicates that the international arena is a competitive one in which the less skilful must expect to pay the price of their ineptitude. The situation provides enough incentive to cause most of the actors to behave sensibly.

Finally, Waltz stresses that neorealist theory alone cannot, and need not, predict foreign policy:

> Just as market theory at times requires a theory of the firm, so international-political theory at times needs a theory of the state [35]

If anarchy selected only by eliminating and relegating non-conformist states, drawing a conclusion that states will behave prudently from these observations would seem odd. This passage seems to imply both that processes which occur outside of the model might increase diversity of behaviours and that the system will be slow to check this diversity. Waltz does not set out to explain how foreign policy is generated. He therefore allows foreign policy to be generated outside of the model (presumably within the states themselves), and allows that states are free to choose their foreign policies. For example, in his earlier work Waltz provided a comparative analysis of how British Prime Ministers and American Presidents direct their countries' respective foreign policies which emphasised the influence of those countries' party systems[36], a factor which clearly falls outside his neorealist theory. Because they are generated outside of the model, these policies need not necessarily conform with the logic of the system. In other words, foreign policy-making processes could increase the diversity of behaviours among the states which constitute the system. The status quo is always (according to Waltz) dominated by prudent states. If foreign policy generation were not constrained by his theory, then Waltz would give us no reason to believe that imprudent policies will not be generated as well as prudent ones. Given that the existing states are (according to Waltz) almost all going to be behaving prudently, any increase in diversity is likely to reduce the average level of prudent behaviour. If elimination of non-conformist states were the only force in Waltz's model, then diversity of behaviours would be reduced only by the fact that non-conformist states tend to be destroyed or to become so weak that their behaviour becomes irrelevant to the system as a whole. The rate of elimination would need to be high enough that imprudent behaviours could not proliferate faster than the system sanctioned them.

An analogy may help to clarify. States' foreign policy-making has a place in Waltz's model similar to the place of genetic mutation and sexual recombination in Darwin's.

Mutation and recombination are exogenous to Darwinian theory but, by generating diversity among animals on which selection can act, they are absolutely fundamental to explaining evolution[37]. Genetic mutations and sexual recombination are not explained by evolutionary theory. They occur as a result of chemical processes at the genetic level, of which Darwin himself was of course completely unaware. He simply observed that there was change in animals' characteristics with each new generation, and did not attempt to explain why. This change, while not exactly random in a statistical sense, could not be predicted by the theory and so might as well be treated as random for the purposes of his argument because it was not predicted by any other factor he could account for. By taking the occurrence of random variation for granted, Darwin was able to concentrate on explaining how natural selection constricts this variation and keeps populations of animals well-adapted to their environment – even if that environment changes slowly over time. This created a viable theory when the mechanics of heredity were not fully understood.

By the same token, it is not necessarily unreasonable for Waltz to simply accept that foreign policies are made by forces outside of the neorealist framework and then explain how the international-political system limits their diversity[38]. In fact, he has argued vigorously that he does not need a theory of foreign policy.

However, if foreign policies are exogenously-generated *and* elimination is rare then elimination alone cannot explain convergence around security-enhancing behaviours. If the only force constraining diversity acts more slowly than the force increasing it, then obviously diversity will increase. And it would seem that foreign policymaking would be likely to increase diversity, if only because it would be difficult for the behaviour of great powers to become any more homogenously prudent than Waltz's portrait of the status quo. Thus, a force external to the model is increasing diversity, and elimination of imprudent states is

reducing it. But because elimination is rare, it can only slowly reduce the diversity of behaviours. Foreign policy-making could well increase diversity faster.

Consider this analogy. We know that rabbits can be born black, brown or white, because pet rabbits come in all three colours. These represent three different mutations of the gene which controls fur pigmentation. In temperate climates, we can predict that almost all wild rabbits will be brown. The reason, obviously, is that brown rabbits are less conspicuous to predators. Brown is the prudent colour for a wild rabbit to be. While mutations can easily generate white and black rabbits, we never see them because they are much more likely to be eaten than brown rabbits. But this is only because the mutation rate is relatively low and the death rate is high. If the average rabbit had five white and five brown offspring, and on average one brown offspring and two white offspring were eaten every generation, there could still be many white rabbits in the wild. In the short term mutation and natural selection work in opposition to each other, one increasing diversity of fur colour and one reducing it. The relative speeds of mutation and selection are important in determining how diverse the population is.

If behaviours do converge, this implies that either elimination reduces diversity of behaviours faster than other factors increase it (unlikely), or that elimination is not the only force causing behaviours to converge. And, of course, it is not. ‘Socialisation’ of states into the international system appears to be more important in explaining convergence around prudent, security-oriented behaviours. His observation that elimination is relatively rare emphasises the importance of “socialisation” in Waltz’s model. This imitative process is absolutely pivotal, because Waltz cannot predict convergence on prudent behaviours without it – and without prudent behaviour by most influential states in the system all the consequences of prudence, including the balance of power, do not follow. It is in analysing “socialisation” that modern Darwinian theory really becomes invaluable. While Darwin

himself might have been comfortable with what Waltz has to say about socialisation, *modern* Darwinian theory suggests that we should be very wary of assuming that imitation leads to convergence on prudent behaviours.

Socialisation in Theories of International Politics

Waltz's model does not rely entirely on states randomly choosing strategies and suffering the consequences (elimination or relegation) if those strategies turn out to be misguided. He allows for a degree of intelligent judgment to shape states' behaviour in response to the perceived challenges of their environment. Waltz claims that states learn from their competitors. One example prominent in *Theory of International Politics* is the Prussian Staff System[39]. The staff system was a mechanism by which Prussia transferred some traditional functions of army commanders – distinguished battlefield leaders with limited formal training – to professional staff officers who were intensively trained in the unglamorous technical elements of contemporary warfare, such as planning supply lines. This superior system of military organisation was widely believed to give Prussia an advantage over its neighbours, contributing to several victories. Once other states perceived this, they quickly developed Staff systems of their own. This process of imitation changed the selective pressure within the system, affecting the environment faced by both Prussia's competitors and Prussia itself.

Allowing for states to imitate may appear, superficially, to compensate for the slow rate of elimination in international politics compared with economics or biology. Socialation is much quicker than the elimination, and so it appears as if behaviours might converge even when elimination is infrequent[40]. The educational example of seeing only a few states which paid too little attention to their security dismembered should motivate others to adopt prudent, security-oriented behaviours. If Waltz's states perceive their behaviours to be making them

less secure they can change them before they become so badly damaged that they have become irrelevant to the system.

Thus, Waltz's model includes natural selection in the system but also allows for states to identify and converge on successful strategies through imitation. Imitation creates a simple one-way transfer. Waltz's concept of "socialisation" is a more fluid, dynamic process[41]. When most of the states imitate, this takes on a reciprocal dimension which adds fluidity the system. By innovating, Prussia gave its competitors an incentive to innovate, and was briefly a 'role model'. But when its neighbours adopted staff systems this changed the selective environment faced by Prussia itself. Now it faced a new environment, and had it reverted to its old pattern of military bureaucracy it would have faced serious danger. International politics developed a kind of self-generating motion characteristic of a Darwinian system. Socialisation is therefore much more than just imitation, but imitation is a necessary ingredient.

Waltz's structural theory of international politics is therefore in tension with evolution driven primarily by natural selection, which most modern biologists see as the main driver most of the time. If animals are born into a world for which their inherited traits are ill-suited, they cannot learn new traits to save themselves[42] unless they belong to fortunate species of intelligent learners (which few do[43]). But Waltz allows that states can deliberately adopt new strategies to save themselves from the wayside. Waltz chooses the diffusion of the Prussian Staff system as an example precisely because other states did not retain their existing, less efficient structures and wait for their impending defeat by the Prussians[44]. Instead, neighbouring states' militaries learned from Prussia's success and imitated the staff system.

Imitation can be quicker than elimination, and this learning element of the model means that, even without a strong selective effect from differential elimination, behaviours need not be randomly-generated. The system appears to influence not only the different fates of states

which show particular behaviours, but also influences what behaviours they exhibit in the first place.

However, imitation in turn raises several questions. Why does Waltz see socialisation as necessarily working in the same direction as elimination, rather than opposing it to increase the diversity of behaviours? Why should states be more likely to imitate a *successful* competitor? And how do they restrict their imitation to those behaviours which are responsible for its success? States might behave prudently and adopt behaviours which enhance their security, or they might adopt behaviours which seem appealing for some other reason, or behaviours which only *seem* to enhance security.

What Waltz does not discuss in any depth is why we should expect behaviours which enhance the security of the state to be those which are imitated. It might have been taken for granted in the economic theory of the 1940s and 1950s that firms adopt strategies which enhance their position in a competitive market, but the death rate in these markets is much higher. Firms therefore receive much more direct feedback on what works, and will probably not exist for very long if they are self-indulgent. This may not be true of states.

Identifying which behaviours are prudent is far from a simple task. Consider the information necessary to a security-seeking state. Leaders may well wish to imitate a more successful rival. Presumably if they wish to imitate a successful rival they would wish to copy the behaviours responsible for that success. But there is ample literature on the difficulties of predicting whether a policy, or institution, will transfer successfully into a new institutional context[45]. Strategies which work well in some circumstances may fail in others, and predicting which contexts will prove compatible is notoriously difficult. For example, the staff system which influenced states' behaviour in wartime (by determining who made the strategic decisions, such as the implementation of the Schlieffen Plan) did not operate in a vacuum, but had to interact with the military recruitment and even the education systems of

the adopting states to produce/select effective military planners. Mistaken imitation is therefore a very real possibility. Ideas which worked for the Prussians might not work so well in a different institutional context. Imitated behaviours may not be compatible with other strategies to which the imitator is committed.

The nature of socialisation in Waltz's model also adds a temporal element to this uncertainty. Behaviours which helped one state become secure in the past could be disastrous given a change in circumstances. Because socialisation is a fluid process, and each state's behaviour affects the others' environment, the selective pressure a state faces changes over time. Therefore, what is prudent is to some extent in flux. Given the difficulty of predicting which behaviours and institutions will be most effective, states will probably make the wrong choices as often as the right ones.

It therefore seems improbable that states can reliably identify behaviours which will enhance their security in advance. This implies that either socialisation generates its own equilibrium, according to its own logic, or that states are able to react to constant feedback from the system.

One possibility is that the process of socialisation itself determines which behaviours are appropriate, according to its own logic. This is a possibility because socialisation is reciprocal. It is conceivable that a fashion for imitating a particular behaviour could create a selective environment which is actually favourable to that behaviour, making units which exhibit it more likely to survive, prosper, and be imitated[46]. If the appropriateness of a behaviour depends on the other units' behaviour, then behaviours which are compatible with each other could become sustainable *because* other states are socialised into them. For an evolutionary analogy, consider the magnificent plumage of a male pheasant. This is often a liability to males. There is no 'objective' reason females should prefer plumage. But once enough females do prefer it, females who choose not to are at a disadvantage. Their sons will

be less likely to inherit plumage, less likely to attract mates, and less likely to provide grandchildren. Such self-generating dynamics are common in Darwinian systems[47]. A fashion for plumage in males, even if it was eccentric when it began, could become self-reinforcing.

While this is one possibility, it does not seem to be what Waltz has in mind. For one thing, he is keen to stress the eternal relevance of neorealist prescriptions. If the appropriateness of behaviours were contingent on imitation and fashions, they could not be so eternal as he suggests. It would also be extremely difficult for an analyst to deduce which behaviours were likely to be favoured from his model.

The alternative is that states are able to react to constant feedback on their security situation gathered from the environment, and will adjust their behaviour to compensate. While elimination and relegation of powers to insignificance is relatively rare, Waltz seems to have something less dramatic in mind when he says that states 'wax and wane'. States' relative power may change over time. Intuitively, we would expect that states can react to diminution of their power short of elimination, treating this as a sign that their behaviours will, in the long run, increase their odds of evisceration in the future. Their competitors might also be dissuaded from imitating them. But would this constitute reliable feedback to which Waltz's states would necessarily react?

Again, this would be far from unproblematic. Firstly, states cannot necessarily assume a linear relationship between power and security. Napoleonic France and Nazi Germany both reached the peaks of their power immediately before their security was dramatically undermined. The belief that more power can sometimes lead to less security defines Waltz's defensive neorealism. Accordingly, states need some way of knowing whether power-enhancing behaviours pose a threat to their own security. More profoundly, however, if there is a possibility of imitating other states' imprudent behaviours then modern Darwinian theory

suggests that the system will not provide the kind of feedback needed for states to choose the most prudent behaviours.

To understand why, we need to consider why Darwin's competition-based theory of evolution dominates biology. Darwinian selection is needed to generate the kind of feedback which will lead the units in a system to converge on behaviours appropriate to their environment. Unfortunately, Waltz's concept of socialisation seems to have more in common with the 'Lamarckian' view of selection, which cannot.

Lamarck's Feedback Problem

Natural selection was not the first superficially-plausible explanation which had been offered to explain evolution. In 1809, the year Darwin was born, Jean-Baptiste Lamarck published his theory to explain how evolution could occur without God constantly intervening to create new species. Lamarck is well-known for the premise on which his theory was based, the inheritance of acquired characteristics, now colloquially called 'Lamarckism'[48]. Analysts who stress the role of ideas and norms in shaping states' behaviour have tended (implicitly or explicitly) to argue that the transmission of ideas between states is Lamarckian[49]. If Lamarckian inheritance were viable, this might mean that socialisation and elimination would point in the same direction. States would react to feedback from the system reducing their security by constantly learning. Unfortunately, Lamarckian transmission would almost certainly not be able to provide that kind of feedback.

The distinction between Darwin's theory of natural selection and Lamarck's inheritance of acquired characteristics is easily explained using the evolution of the giraffe as an example. Giraffes have long necks which allow them to eat leaves from the tops of tall trees. The fossil record shows that giraffes descend from an ancestor species which did not have the giraffe's long neck[50]. A Lamarckian explanation would be that members of the ancestor species developed a habit of feeding on the highest leaves of very tall trees, and as a result were constantly stretching their necks. The repeated stretching would slightly lengthen the neck of each successive generation, and each generation would (somehow) pass on this acquired characteristic to its offspring. Over time, the habit of stretching for high leaves would greatly change the shape of giraffe-ancestors' necks.

Darwin's new mechanism of natural selection removed the need to believe that characteristics which giraffe-ancestors acquired during their lifetime could be passed on to their offspring directly. Giraffes' ancestors would produce offspring with necks of varying

lengths. The offspring with the longest necks would be better able to feed from the tops of trees, where there was abundant food. The offspring with shorter necks would have to compete for leaves on the lower branches, and in the face of this competition would be more likely to starve to death or to be undernourished and weak[51]. On average, they would be less able to reproduce or to care for their offspring and thus would have fewer descendents than their long-necked relatives. Many would quite literally "fall by the wayside", collapsing and probably being devoured by scavengers. The long-necked giraffe-ancestors would tend to produce offspring which shared the same long necks[52], until eventually a new long-necked species (which humans would call "the giraffe") evolved.

Today, of course, we know that Darwin's principle of natural selection offers a superior explanation for biological evolution. Our understanding of genetics provides empirical evidence for this. We know that the genetic content of eggs and sperm cannot be influenced by other cells in the body, so changes which occur in other cells during an animal's life have no direct impact on future generations[53]. However, Charles Darwin himself (writing in the mid-nineteenth century) never learned of genes, and he did not have a detailed understanding of how sperm and eggs transmit inherited characteristics. While it is tempting to portray Darwin as championing Darwin*ism* against Lamarck*ism*, it is not historically accurate. Darwin never claimed that natural selection was *the only* mechanism by which new species can evolve[54]. In fact, he continued to accept that evolution could occur by a combination of natural selection and other mechanisms, leaving the door open for the inheritance of acquired characteristics[55]. This idea was only really laid to rest in the early twentieth century, when the implications of genetic inheritance became clear. Until then, Lamarckian ideas remained and may have influenced economic theorists who in turn influenced Waltz.

Empirical evidence that biological evolution is not driven by a Lamarckian process does not, of course, mean that the evolution of political systems cannot be Lamarckian. Some

economists have believed that Lamarckian imitation drives convergence of behaviours among competing firms[56], and so, apparently, does Waltz. The socialisation element of his model effectively relies on successful states developing strategies, and those strategies being imitated. States which try to import new practices to protect themselves are not simply making do with the hand Fate has dealt them, as animals do in natural selection. They copy. Not only do they copy, but they copy learning from the copying of others. Other states learned from Prussia's staff system, but Prussia itself had to develop that innovation based on the challenges of its environment. Prussia was not created with its system of military bureaucracy fully formed and immutable. Instead, Prussian officials guessed a new form of organisation would be most useful given their state's environmental challenges and adopted it. The new form was then imitated. Unlike animals, states do not have rigidly-defined reproductive components – if states inherit ideas from each other, they inherit ideas which have been polished and adapted based on years of use. If states inherit, they inherit both inherited and acquired characteristics. In "socialisation", Waltz mixes quasi-Lamarckian ideas with natural selection[57].

But modern Darwinians' objections to Lamarckism are not based solely on empirical evidence. Rather, as both Hodgson and Knudsen[58] and Dawkins[59] explain, evolution through the inheritance of acquired characteristics raises *theoretical* problems. Modern Darwinian analyses show that if Lamarckian inheritance occurs it will not lead to units becoming better-suited to their environments. When Waltz acknowledges a quasi-Lamarckian possibility of inheriting acquired traits, he imports the limitations of Lamarckian reasoning.

We can see from the world around us that evolution is not a random process, but one which leads to animals remaining well-suited to their environments even as those environments change. In order to explain why this occurs, any theory of evolution needs some means of distinguishing between beneficial and injurious characteristics. Many if not most changes

which occur in animals' bodies will result from injuries. Animals may tone up especially useful muscles, but they also break their teeth and sometimes bones. A theory based on natural selection very clearly defines injurious characteristics – an injurious characteristic is one which reduces an animal's odds of leaving offspring. If acquired characteristics are inherited, then injuries can influence which characteristics an animal leaves to its offspring just as much as any other environmental influence which may affect its lifestyle.

Suppose a giraffe-ancestor fell and permanently damaged the bones in one leg. In order to continue to walk, it would need to distribute its weight differently among its muscles. Even if its offspring were somehow born with all their bones intact (and as Hodgson and Knudsen point out, Lamarckian accounts tend to be vague on why offspring do not inherit fractures or age-related health problems) the pattern of use and disuse of muscles would still be inherited. If this pattern of muscle strength were only compatible with walking in a distorted posture, then that posture would be inherited and the offspring would hobble inefficiently from tree to tree. Only the possibility of natural selection can distinguish this as an injury by killing off giraffe-ancestors which inherited it. If there were no natural selection in the system, modifications which resulted from injuries would quickly become ubiquitous – since most adults which live long enough to reproduce acquire some injuries along the way. A hobbling giraffe-ancestor in a Lamarckian world could beget many hobbling offspring if it had easy access to food and a low probability of encountering a predator. Only the fact that life for the ancestors of real giraffes was tough, with regular predation and shortages of food and potential mates, explains why the modern giraffe became so ideally-suited to its niche within the ecological system. Waltz's model of the international political system cannot show us why states cannot similarly tend to retain traits which are suboptimal for their survival.

As Hodgson and Knudsen put it:

> Prominent cases of acquired characteristics include injuries and other impairments. But, for species to evolve, the effects of such deleterious acquired characteristics must be restricted. [...] The only possible explanation for the evolution of the limits necessary to filter the many useless and injurious characteristics is natural selection. Accordingly, Lamarckism depends on the Darwinian principle of selection in order to explain why any disastrous propensity to inherit acquired impairments does not prevail [...] If Lamarckism is valid in any particular domain, it depends on Darwinian mechanisms of selection for evolutionary guidance.

Giving serious thought to the implications of Lamarckian inheritance quickly reveals that, unless we are to impute some magical drive to perfection to units in a selective system[60], it needs rapid selection to explain units' consistent movement towards characteristics and behaviours well-suited to their environments. Given the difficulty of identifying beneficial behaviours in advance, regular elimination of failing units is needed to distinguish good inheritances from bad inheritances[61]. In other words, even if there is the possibility of Lamarckian inheritance, some form of elimination ends up doing all the work which causes convergence on traits that are suited to the environment. Without natural selection, Lamarckism would spread traits almost randomly. Therefore, imitation of the successful by their rivals is unlikely to be sufficient to make states converge on prudent, security-enhancing behaviours which are as timeless as Waltz suggests.

Waltz's model seems to explain convergence of behaviours by combining a slow rate of natural selection with the rapid imitation of strategies which appear to have been successful elsewhere. Unfortunately, in order for natural selection to explain why units in the present would converge on particular behaviours, units in the past would need to have been subjected to a high degree of selective pressure. Units which existed in the past and were well-suited to

their environment would need to exert a very strong influence on how states which exist in the present behave; the characteristics of states which did not conform to the logic of anarchy would need to be quickly removed from the system. The international system, however, combines the possibility of imitating injurious behaviours with a low "death rate". The Lamarckian nature of socialisation suggests divergence from strategies which are objectively well-suited to anarchy, the strategies we might be able to predict by reasoning about the behaviour of states in an idealised system. Harmful behaviours may be imitated. Because imitation is quick, imprudent behaviours can spread much more quickly than the elimination and relegation of imitating states by more-successful competitors can keep them in check.

Taking account of the quasi-Lamarckian dimension to Waltz's model actually emphasises the importance of elimination in causing systematic convergence of behaviours. If animals could inherit acquired characteristics, both characteristics useful to the parents during their lifetime and characteristics which result from injuries could be inherited. By the same token, if states can imitate each others' novel institutions and behaviours they might acquire useful tools for ensuring their security, but they might also imitate those which will turn out to be harmful to the imitated state in the future. The useful characteristics are by definition those which will enhance the unit's chances of surviving at its current position in the system, so it is crucial to be able to distinguish one from the other. When we combine the possibility of Lamarckian inheritance with natural selection, only natural selection checks the spread of injurious characteristics and behaviours. If the rate of natural selection is low, this check becomes less effective. If it is low enough (in other words, if survival is easy enough even when a unit's characteristics are suboptimal) acquired injuries may be passed on to new generations faster than they can be eliminated.

Simply stating that the units are parts of a competitive system[62] does not, therefore, tell us how they are likely to behave unless we follow it with more assumptions about the nature of

that system. Modern Darwinian thought allows for many outcomes of selection, with the resulting units showing a wide range of behaviours from extreme egoism to altruism. There are many ideas in evolutionary theory which might be significant for international politics. Among the most obviously relevant to this discussion are ideas building on William Hamilton's and Richard Dawkins' work, culminating in the popular theory that genes act as the primary units of selection ('selfish gene' theory'). This challenges head-on the idea that a selective system will lead to self-preserving behaviours becoming ubiquitous.

Alternative Outcomes of Selection

Writing in the nineteenth century, Darwin was unaware that characteristics are inherited through discrete genes[63]. As a result, he tended to focus on competition among individual animals to survive and reproduce. In the early twentieth century, Darwinian thought was transformed by a synthesis with the genetic theory of inheritance. Modern Darwinism acknowledges competition among units for survival and reproductive opportunities, but evolution can often be better understood as competition among individual genes for expression within a population. Richard Dawkins' work has been hugely important in popularising the idea that the behaviours which spread a gene will not always be those which preserve the body it is currently inhabiting: there are many situations in which the selective pressures on individual genes and on whole animals diverge. In those situations, the interests of the genes take priority[64].

In the same way, Waltz's Theory of International Politics can be read better as an account of why particular *behaviours*[65] are widespread among major powers than an account of why the USA and USSR were major powers. His system punishes and rewards states, but the consequence of this is to encourage the spread of self-regarding behaviours at the expense of other behaviours. Modern Darwinians can often explain animal evolution better by seeing the natural world as an arena in which genes compete against each other, and the victors become widespread in the population (the "gene's-eye view"[66]). In other words, genes and behaviours, not animals and states, are the units of selection.

Even though modern Darwinian biologists, like neorealists, see the world as an anarchic arena in which competing strategies are tested against each other and the characteristics of the winners proliferate, they do not assume that this leads to convergence on self-regarding behaviour. In fact, genes which are actively harmful to the survival prospects of the animal which carries them can and do proliferate. Worker bees will sacrifice themselves for their

nestmates; salmon swim upstream to their deaths every mating season. These behaviours perpetuate the genes which cause them even while destroying the body they are currently inhabiting[67]. Treating the gene as the unit of selection, the only criterion for success is that more copies of that gene exist in the future than did in the past. The fate of the individual, mortal animal which hosts a gene temporarily is largely irrelevant[68]. For example, modern Darwinism can explain why individual animals, such as worker bees which serve the queens rather than breeding themselves, will sacrifice their own reproductive capacities and often their lives for others; due to a quirk of insect genetics, worker bees get more copies of their own genes into future generations of bees by caring for their sisters' offspring than they would by breeding themselves[69]. Time and again, the evidence has shown that the traits which become widespread in animals are not necessarily those which preserve the animals that carry them, but rather those which make those animals produce more copies of the trait. Logically, this should apply to selective systems in general; the traits widespread in the present will be those which were successful in being disseminated in the past.

Just as in animals, traits which reduce a unit's security might proliferate – if they had other attributes which made them likely to be copied into other units. This suggests Waltz's model of selection is not the only possibility we can extrapolate from his observation that the international-political system is anarchic and selective. Neorealist theory does not, of course, offer much of a clue as to what kinds of other factors might affect this likelihood. For that, we would need to look elsewhere, perhaps to organisational sociology or studies of scientific innovations[70] - or even to constructivist ideas.

Conclusion

Modern Darwinians argue convincingly that we can expect units in a selective system to converge on the behaviours best-suited to the environment only if units carrying inappropriate traits are systematically less likely to reproduce. Waltz concedes that states are rarely eliminated from the system, and even the relegation of states from great power status to the lower divisions is not common. This makes distinguishing problematic behaviours difficult. If states can acquire deleterious characteristics through imitation faster than the system punishes them, it is entirely possible for deleterious traits to spread. Waltz's model cannot show us that states' behaviour will automatically converge around the best means to security unless unsuccessful states risk being eliminated, or relegated from the ranks of the major powers with which his theory is concerned, faster than they can be imitated.

Biologists have observed many empirical cases of behaviours which risk animals' lives yet which still appear to be favoured by the system. This can occur whenever the increased odds of a given trait being copied into other units outweigh harm to its current host. Waltz's model does not, by itself, show why the same could not be true in the international political system. If the system eliminates/relegates non-conformist states more slowly than states can imitate each other, they may converge on imprudent behaviours. While we might be able to deduce how states would ideally maintain their security, we do not have an obvious way to predict how imprudent imitation might lead them to diverge from this ideal.

There has been extensive discussion in the pages of this journal of Waltz's metatheoretical position[71]. Showing what his model of the international system cannot do may tell us something about what it can. Waltz's many critics may not be quite so far from his pattern of reasoning as we often think, because a Darwinian understanding of the international system which retained much of his reasoning could also generate very different outcomes from those Waltz presents. There is plenty of space for a constructivist, or perhaps even some variants of

postmodernist, to argue that their interpretation of how states are likely to behave is compatible with modern Darwinian logic. The system need not eliminate behaviours which increase a state's vulnerability, and so they can proliferate according to whether or not they appeal socially.

A selective system on its own cannot cause its units to converge on prudent behaviours unless there is a high death rate. This does not mean that imprudence does not sometimes lead to suffering. It is possible that imprudent behaviours will spread *even though* they sometimes lead to suffering. Behaviours might seem appealing, and be widely imitated, even if they are bad for the survival prospects of the state that imitates them. Anarchy does not preclude this. If the system is left to follow its natural course, imprudent behaviours may spread faster than the system can feed back that they are imprudent.

There is also a human dimension. Waltz's model has many Darwinian characteristics, but there is more going on. A fundamentalist Darwinian understanding of the world generates its own rationality. All that matters is the spread of traits, and a good trait is a 'fit' trait, one which gets itself copies into future generations of hosts. There is no need to assume that the units start out as rational actors, because the system is self-regulating in a particularly brutal way. The ecological system eliminates genes that are not good at getting their hosts to make more copies of them, until it is filled with animals carrying genes that are good at getting themselves copied. A curious kind of rationality emerges from such a system, where all that matters is replication. In principle we could, with enough information and imagination, predict how animals will behave by calculating what behaviours would be most likely to get their genes copied. To some extent we do this all the time. Pet owners can safely predict that their animals will pursue food and sex and avoid pain: thinking through the logic of this, they are in effect reasoning that pets will do the things that increase their chances of leaving offspring in the wild. Waltz could be interpreted as implying that the international-political

system has its own internally-generated rationality of survival[72]. I am sceptical that the model he outlines would necessarily generate an 'emergent' rationality in this way as a result of behavioural convergence. But this may miss the more important distinction between Waltz and Darwin. It would be worrying if *any* political analyst were so caught up in the emergent rationality of a Darwinian system as to lose sight of the implications for other humans.

A self-regulating system is unmoved by the suffering of the units that constitute it, or the cells that constitute them. Political life, on the other hand, generates and ameliorates suffering. Waltz, unlike Darwinists who study animals, plants, and microbes, might plausibly hope to improve lives by describing the world in one way and not in another. The minds that influence how political units behave may be open to human persuasion. And taking Waltz's work as a whole, he makes a far-from-trivial case that the system would cause less suffering *if* states behaved *as if* the system compelled them to be prudent.

If Waltz does not show that the system generates an emergent rationality in its units, then this only increases the importance of debate about his work as a policy prescription. If imprudent behaviour can spread, despite its costs, then encouraging states to take the course most likely to ensure their security becomes crucial. And Waltz has a normative commitment to the security of what he values[73]. Darwinian ideas are useful for interpreting Waltz, but Waltz – unlike a biologist – has the option of trying to find the course which will minimise *human* suffering and persuading units to follow it.

Encouraging states to behave like rational power-seekers might have positive consequences. Waltz's model simply does not show that they *will* do so if left alone to interact. Thus, the normative commitment takes on greater importance. We need not interpret *Theory of International Politics* as a positive model of how the world must be. States could choose to heed the siren calls to imitate imprudent policies, and the system could not prevent them. I suggest that, for Waltz, this is the whole point of pleading with them not to.

[1] Ken Booth, 'Conclusion' in Ken Booth (ed.), *Realism and World Politics* (New York: Routledge, 2010).
[2] Or indeed plants and microbes
[3] Charles Darwin, *On the Origin of Species, Abridged and Introduced by Richard Leakey* (London: Faber and Faber, 1986[1859]).
[4] Kenneth Waltz, *50 and 30 Years On*, address to the 2008 'King of Thought' Conference, Department of International Politics, Aberystwyth, available at http://www.aber.ac.uk/en/interpol/news-and-events/videocasts/waltzconference2008/. The overarching model discussed here is expressed most clearly in his *Theory of International Politics* (Boston: McGraw-Hill, 1979) but develops from *Man, The State, and War* (New York: Columbia University Press, 1959). See Hidemi Suganami, 'Understanding 'Man, the State, and War'', in Ken Booth (ed.) *Realism and World Politics* (New York: Routledge, 2010).
[5] Jennifer Sterling-Folker, 'Evolutionary Tendencies in Realist and Liberal IR Theory', in William Thompson (ed.), *Evolutionary interpretations of world politics* (London: Routledge, 2001), Alexander Wendt, *Social Theory of International Politics* (Cambridge: Cambridge University Press, 1999).
[6] Kenneth Waltz, *Theory of International Politics*, p118.
[7] Kenneth Waltz, *Theory of International Politics*, pp73-7.
[8] Orion Lewis and Sven Steinmo, 'How Institutions Evolve', *Polity* 44(3), 2012, pp314-39, Robin Dunbar, 'Evolution and the social sciences', *History of the Human Sciences* 20(2), 2007, pp29-50.
[9] Kenneth Waltz, *Man, The State, and War*.
[10] Bradley Thayer, 'Bringing Darwin Back In', *International Security* 25(2), 2000, pp124-51.
Bradley Thayer, *Darwin and international relations* (Lexington: University of Kentucky Press, 2004).
[11] For a contrary view, see Neta Crawford, 'Human Nature and World Politics', *International Relations* 23(2), 2009, pp.271-88.
[12] Ian Lustick 'Taking Evolution Seriously', pp4-8.
[13] Kenneth Waltz, *Man, The State, and War*.
[14] Jennifer Sterling-Folker, 'Evolutionary Tendencies in Realist and Liberal IR Theory', Alexander Wendt, *Social Theory of International Politics*.
[15] Matthias Kelm, 'Schumpeter's Theory of Economic Evolution', Geoffrey Hodgson and Thorbjørn Knudsen, *Darwin's Conjecture* (Chicago: University of Chicago Press, 2010), Ian Lustick, 'Taking Evolution Seriously', *Polity* 43(2), 2011, pp.179-209, esp. pp12-13.
[16] Orion Lewis and Sven Seinmo, 'How Institutions Evolve'
[17] Geoffrey Hodgson and Thorbjørn Knudsen offer an introduction in *Darwin's Conjecture*.
[18] See Ian Lustick, 'Taking Evolution Seriously'.
[19] See the indexes of *Theory of International Politics*, *Man, The State, and War*, *Democratic Politics and Foreign Policy* (New York: Longmans, 1967), and *Realism and World Politics* (London, Routledge, 2008).
[20] Peter Bowler, *Darwinism* (New York: Twayne, 1993)
[21] Matthias Kelm, 'Schumpeter's Theory of Economic Evolution', *Journal of Evolutionary Economics* 7, 1997, pp97-130.
[22] Kenneth Waltz, *Theory of International Politics*
[23] For example, in *Theory of International Politics*, pp26-8 and *Realism and World Politics*, pp68-70.
[24] See note 47 on page 19 of George Modelski, 'Is World Politics Evolutionary Learning?', *International Organization* 44(1), 1990, pp1-24. Schumpeter's own intellectual relationship with Darwin is very complex, as described by Matthias Kelm, 'Schumpeter's Theory of Economic Evolution', *Journal of Evolutionary Economics* 7, 1997, pp97-130. Revisionist intellectual histories have cast doubt on a traditional assumption that Schumpeter was directly influenced by Darwin, although there are clear intellectual parallels between the two men's selective reasoning which suggest some shared influence (*ibid*). When Schumpeter was writing, Darwinism was an unfashionable minority interest among evolutionary biologists, championed by a relatively small group inspired by Charles Darwin's own work (*ibid*. pp.109-11). Modern Darwinism came to dominate evolutionary biology only after a synthesis of Darwin's theories with an understanding of genetics in the mid-twentieth century, and this synthesis both involved a reinvention of Darwinian thinking and greatly increased its diversity. Neither Darwin nor Schumpeter was aware of the implications of genetics for how evolutionary biologists reason about selection. Naturally, Waltz also shows no signs of being conscious of this reinvention. To what extent Schumpeter was really influenced by Darwin, and to what extent he generated his parallel argument independently from the same priors, is less important to my argument than that modern Darwinian reasoning diverges from both.
[25] See Kenneth Waltz and James Fearon 'A conversation with Kenneth Waltz', *Annual Review of Political Science* 15, pp1-12.

[26] Richard Nelson and Sidney Winter, 'Evolutionary Theorizing in Economics', *Journal of Economic Perspectives* 16(2), 2002, pp.23-46; Matthias Kelm, 'Schumpeter's Theory of Economic Evolution'

[27] Along with Alfred Russel Wallace, who independently generated the idea while Darwin was writing his book. See Peter Bowler, *Darwinism*, p23, David Hull, 'Deconstructing Darwin', *Journal of the History of Biology* 38(1), 2005, pp.137-52, Curtis Johnson, 'The Preface to Darwin's Origin of Species: The Curious History of the "Historical Sketch"', *Journal of the History of Biology* 40(3), 2007, pp.529-56: pp.534-6, 540, Jennifer Sterling-Folker, 'Evolutionary Tendencies in Realist and Liberal IR Theory', pp.68-9.

[28] Rose McDermott, James Fowler and Oleg Smirnov provide a review and critique in 'On the Evolutionary Origin of Prospect Theory Preferences', *Journal of Politics* 70(2), 2008, pp335-50.

[29] Kenneth Waltz, *Theory of International Politics*, p92, 118

[30] 'Offensive' neorealists, by contrast, argue that states do not limit their pursuit of power, and seek to dominate their neighbours. As acquiring excessive power relative to competitors provokes opposition, there is an ever-present risk of conflict. For an archetypal 'offensive' analysis see John Mearsheimer, *The Tragedy of Great Power Politics* (New York: WW Norton, 2001).

[31] Kenneth Waltz, *Theory of International Politics*, Ch4.

[32] Kenneth Waltz, *Theory of International Politics*, p118.

[33] Robert Keohane, 'Theory of World Politics', in Robert Keohane (ed.) *Neorealism and its Critics* (New York: Columbia, 1986), p173, Kenneth Waltz, *Theory of International Politics*, p95, *Realism and World Politics*, 43-4.

[34] This low death rate in competition among states also suggests that one work which does take an evolutionary approach, Hendrik Spruyt's *The Sovereign State and Its Competitors* (Princeton, Princeton University Press, 1994) has different implications for neorealism. Spruyt's celebrated analysis of the rise of the nation-state discusses the specifics of competition between different, and incompatible, types of unit (or 'species'). Waltz is interested in the generality of competition among units which are not divided into rigid categories and have the potential to converge and diverge in their behaviour. Spruyt argues that when sovereign states emerged other 'species' of political unit struggled to compete with them, and thus elimination of non-states by states was widespread. Empirically, there seems to be acceptance that competition between like units results in elimination much more rarely. Hence, my argument from Darwinism reaches different conclusions

[35] Kenneth Waltz, *Realism and World Politics*, p44.

[36] Kenneth Waltz, *Democratic Politics and Foreign Policy*

[37] Richard Leakey, 'Introduction' to Darwin's *Origin of Species, Abridged and Introduced by Richard Leakey* (London: Faber and Faber, 1986).

[38] He would, if you like, be content to wait for the international-political equivalent of Mendelian genetics to come along with a complementary theory explaining how foreign policies are generated in some way that is compatible with neorealism.

[39] Kenneth Waltz, *Theory of International Politics*, p127-8

[40] See Lars Cederman and Kirsten Gleditsch, 'Conquest and Regime Change', *International Studies Quarterly* 48, 2004, pp.603-29, especially pp606-7.

[41] Although see Alexander Wendt, *Social Theory of International Politics*, pp101-3

[42] Very recent work in epigenetics may suggest that biological organisms can, in fact, inherit a few acquired characteristics (see Pembrey, M, L. Bygren, G. Kaati, S. Edvinsson, K Northstone, M Sjostrom, J Golding and the ALSPAC Study Team 'Sex-specific, male-line transgenerational responses in humans', *European Journal of Human Genetics* 14, 2005, pp.159-66). This would modify the central dogma which has dominated evolutionary biology for most of the twentieth century, that phenotypes cannot be inherited. However, these fairly restricted exceptions to the rule do not challenges the aspects of modern Darwinism discussed here.

[43] See Daniel Dennett's 'tower of generate-and-test' in *Darwin's Dangerous Idea* (New York: Touchstone, 1995)

[44] Kenneth Waltz, *Theory of International Politics*, p127-8.

[45] Colin Bennett and Michael Howlett, 'The Lessons of Learning', *Policy Sciences* 25, 1992, pp.275-94, David Dolowitz and David Marsh, 'Who Learns What from Whom?', *Political Studies* 44(2), 1996, pp.343-57, Richard Rose, 'What Is Lesson-Drawing?', *Journal of Public Policy* 11(1), 1991, pp.3-30.

[46] Robert Axelrod discusses some examples in The Evolution of Cooperation (New York: Basic Books, 1984)

[47] Richard Dawkins, *The Selfish Gene*, 2nd Edition (Oxford: Oxford University Press, 1989)

[48] This may be a misrepresentation, as Lamarck's new contribution was a teleology which has faded into obscurity. The idea of evolution through inheritance of acquired characteristics predates even Lamarck (see p73 of Pietro Corsi, 'Before Darwin', *Journal of the History of Biology* 38(1), 2005, pp.67-83).

[49] Alexander Wendt, *Social Theory of International Politics*, p326.

[50] The okapi, which has a short neck, is descended from the same ancestor.

[51] Recent work questions whether this venerable argument actually explains the evolution of the giraffe's neck, which may in fact result from an advantage long-necked males gain in ritual contests over mating rights. However, the alternative explanation is still underpinned by natural selection. Robert Simmons and Lue Scheepers, 'Winning by a Neck: Sexual Selection in the Evolution of the Giraffe', *The American Naturalist* 148(5), 1996, pp.771-86.

[52] Jennifer Sterling-Folker, 'Evolutionary Tendencies in Realist and Liberal IR Theory', pp71-2.

[53] Again, a few exceptions have been identified by epigeneticists.

[54] See p147 of David Hull, 'Deconstructing Darwin'.

[55] Darwin opens his conclusion to the later editions of 'On the Origin of Species' by making this abundantly clear:

> "I have now given the facts and considerations which thoroughly convince me that species have been modified during a long course of descent. This has been effected chiefly through the natural selection of numerous successive, slight, favourable variations; *aided by the inherited effects of the use and disuse of parts* [Lamarckian inheritance] ... It appears that I formerly [in the first edition of 'On the Origin of Species'] underrated the frequency and value of [this] latter form of variation, as leading to permanent modifications of structure independently of natural selection. But as my conclusions have lately been much misrepresented, and it has been stated that I attribute the modification of species *entirely* to natural selection, I may be permitted to remark that in the first edition of this work, and subsequently, I placed at a most conspicuous position [...] the following words: 'I am convinced that natural selection has been the main *but not the exclusive* means of modification'. This has been of no avail. Great is the power of steady misrepresentation; but the history of science shows that fortunately this power does not long endure" Charles Darwin, *On the Origin of Species*, p216

Darwin's own view of evolutionary biology seems to have involved a hybrid of natural selection and the inheritance of acquired characteristics, with different mechanisms of evolution dominating in different circumstances. In fact, in later life Darwin struggled to explain the inheritance of enquired characteristics with a theory that hypothetical chemical messengers ("gemmules") flowed from the rest of the body to the germ cells (eggs and sperm), allowing changes in somatic cells to influence offspring characteristics. Debate continues as to how far Darwin himself really believed that acquired traits could be inherited. Darwin was personally very averse to controversy and confrontation, and the first edition of 'Origin of Species' provoked fierce criticism. He may have allowed for some Lamarckian ideas to soften this. Nonetheless, there was a fairly long period before the advent of modern genetics in the 1930s during which Darwin and his followers were identified with the hybrid view. See Peter Bowler, *Darwinism*, Richard Leakey, 'Introduction', Rasmus Winther, 'Darwin on Variation and Heredity', *Journal of the History of Biology* 33(3), 2000, pp425-55. esp. p443).

[56] Geoffrey Hodgson and Thorbjørn Knudsen, *Darwin's Conjecture*, Ch4.

[57] As, indeed, did Charles Darwin himself.

[58] Ibid.

[59] Richard Dawkins, *The Blind Watchmaker*, p300.

[60] Which some of Darwin's predecessors, possibly including Lamarck, did (see Pietro Corsi, 'Before Darwin')

[61] Geoffrey Hodgson and Thorbjørn Knudsen, *Darwin's Conjecture*, Ch4

[62] Kenneth Waltz, *Theory of International Politics*, p95

[63] Darwin never learned of the gene's existence. See Peter Bowler, *Darwinism* (Toronto: Maxwell Macmillan, 1993).

[64] Richard Dawkins, *The Selfish Gene*

[65] Strictly speaking, in evolutionary biology it is not behaviours which are selected but genes, which produce behaviours while interacting with the environment and with each other. Genes are carried by bodies which both express them and offer them their opportunity for reproduction. Although Waltz does not develop this analogy at all, his less widely-read *Foreign Policy and Democratic Politics* (Boston: Little, Brown 1967) implies that the institutions which select a state's leaders also, by extension, influence how that state is likely to react to its environment, which would allow them to play an analogous role. Given limited space here I will develop this analogy elsewhere; it is not essential to my central argument.

[66] Richard Dawkins, *The Blind Watchmaker* (Harlow: Longman, 1986).

[67] Richard Dawkins, *The Selfish Gene*.

[68] More accurately, it is relevant only insofar as animals which survive longer will, ceteris paribus, produce more offspring and therefore copies of their genes. Many animals, such as the Atlantic salmon and several species of male spider which are eaten by the females, run such enormous risks to reproduce that they are effectively committing suicide. This behaviour persists because the genes which produce it acquire new bodies

more effectively than a hypothetical set of genes which encouraged salmon and spiders to aim for a quiet old age.

[69] William Hamilton, 'The Genetical Evolution of Social Behaviour (parts I and II)' *Journal of Theoretical Biology* 7(1), 1964, pp 1-52

[70] A large literature has built on Everett Rogers' *Diffusion of Innovations* (New York: Free Press, 1962)

[71] For example, Jonathan Joseph, 'Is Waltz a Realist?', *International Relations* 24(4), 2010, pp.478-93, Nicholas Onuf 'Structure? What Structure?', *International Relations* 23(2), 2010, pp183-99, Ole Waever, 'Waltz's Theory of Theory', *International Relations* 23(2), 2009, pp201-22.

[72] For example, Kenneth Waltz, *50 and 30 Years On*, in the discussion of rationality between 7:20 and 9:50.

[73] Michael Williams, 'Waltz, Realism and Democracy', *International Relations* 23(3), 2009, pp328-40.